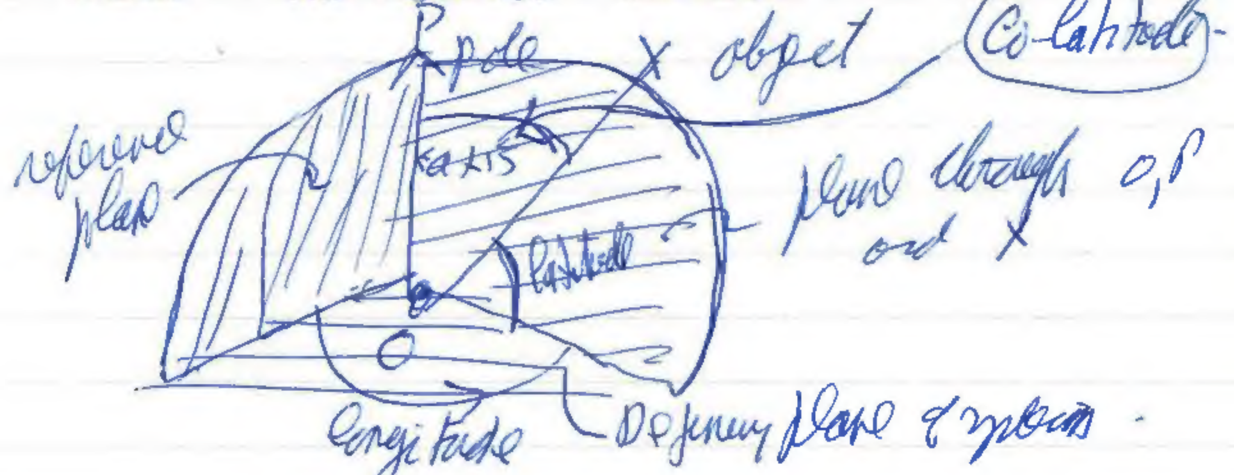
Dear Dr Pratt,

I have given some thought to the Torquetum. The problem is how to use it to measure angular coordinates in the 'horizon', 'equatorial' and 'ecliptic' systems.

In any such ~~us~~ system we have an axis joining the 'reference centre' of the ~~earth~~ system to the appropriate 'pole' P and we have some fixed reference plane through this axis. The angular coords λ ℓ (longitude latitude) of an object X are then measured thus



For our three systems we have.

Pole	~~Ho~~[illegible] System ~~defined by plane of~~	AXIS	Reference plane ~~through axis and~~
Zenith	Horizon	Vertical	~~meridian through~~ the ~~[illegible]~~ north pole point.
North ~~Equatorial plane~~ pole.	Equatorial	Spin-axis of earth	~~through~~ the vernal equinox.
Ecliptic pole	Ecliptic	normal to the ecliptic	~~through~~ the vernal equinox.

Longitude	Latitude.
Azimuth	altitude
Right Ascension	Declination
celestial longitude	celestial latitude.

I shall now refer to the labelled diagram in the printed pamphlet.

To measure Ecliptic coordinates (at once)

Set A of first set circle E in the reference plane defined by the usual equator. First set scale B to the correct date (argument shown on A.) then the brass peg on C points to the usual equinox. Then rotate D to zero on the brass peg on C. E is now in the correct reference plane. Now rotate scale D until the Red on the object X on the rotating arm F. The Rotation of the celestial longitude. The reading of F gives celestial latitude directly. (argument E)

To measure Equatorial coordinates (at once)

We must first set E in the plane defined by the Axis of the equatorial; ecliptic zero. This is done by setting scale D with 90° (argument the brass peg. Now set E in the reference plane through the Solstices (or the equinoxes) by rotating B to the correct date as above. Now rotate B through a further angle zero, to enable us to sight X. Then the Rt. ascension is obtained by adjusting D by 90°. Finally the declination is read off again from reading of F against E adjusted by $23\frac{1}{2}°$. The whole point is that the declination is obtained by adding (or subtracting) the ecliptic obliquity. No

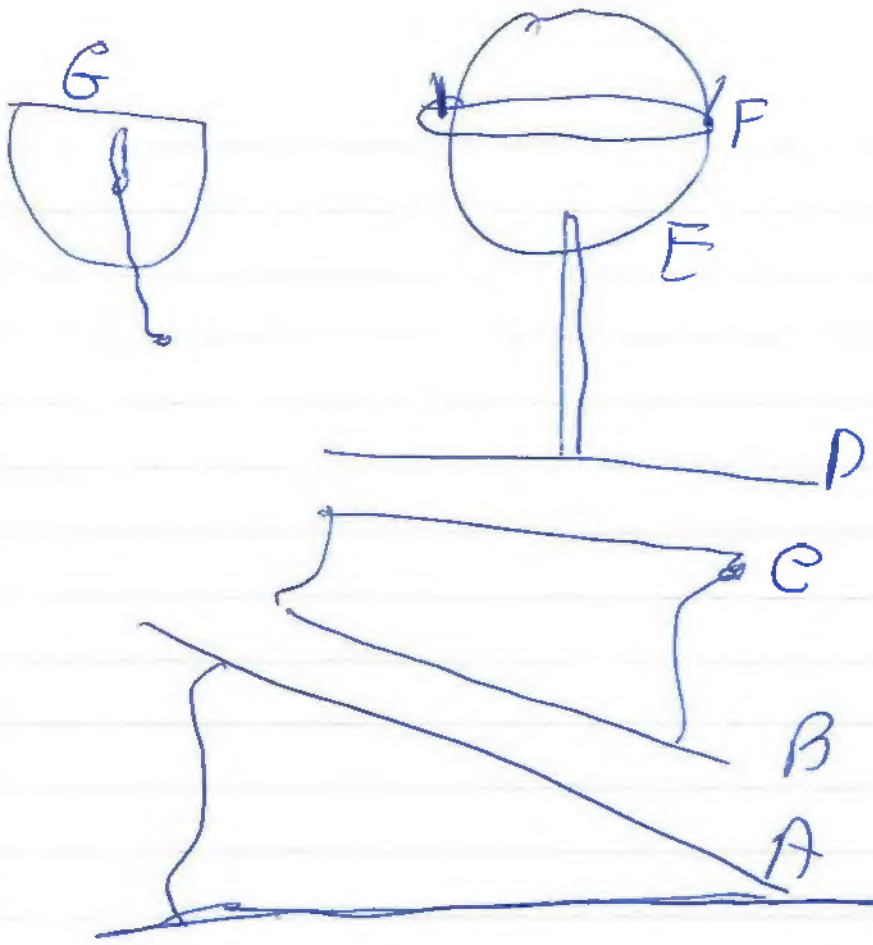
Complicated spherical trigonometry is required to calculate the declination from the ecliptic coordinates.

To measure horizon coordinates

This cannot be done with the instrument as described, since it requires rotational capability of the whole apparatus about a vertical axis, with E set in the meridional plane by ~~turning the brass peg on~~ setting the vernal equinox on B to the 90° mark on A, the scale D being set ~~as for~~ as described for measuring equatorial coordinates. The altitude is now obtained by the reading of F against E adjusted by adding (or subtracting) (Latitude of observing point) ~~[illegible]~~ (Ecliptic obliquity).
Again the measurement of altitude is derived by linear addition or subtraction without the complexities of spherical trigonometry.

However as the instrument you have, it cannot rotate about a vertical axis so azimuth cannot be measured, while altitude is obtained using the device G attached to F.

I haven't had time to check my references in the torquetum.
Those used are:
R.T. Gunther: Early Science in Oxford. (1923-1945)
H.M. Michel ~~Traité~~ (1947)
~~Terre et Ciel~~ Ciel et Terre (1937 and 1944)



Tequetum